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Butterflies behaviors and their Natural Enemies and Predators in Manila, Philippines

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ABSTRACT

The aim of this study is to identify the butterfly's behavior and presences of natural enemies such as parasitic, predator, competitor and pathogen that interfere with the butterflies in captivity**.** Method used Qualitative and Quantitative sampling: was used to quantify the number the natural enemies and behavior toward the butterflies, present in the garden that affected the ecological conservation of the butterflies. The study commenced for a period of one year. from March 2017 up to February 2018. Materials used are DSLR camera for documentation and Microscopes. 95% ethanol was used to immobilize the natural enemies caught in the garden. Insect pins were used to pin the specimens and spreading board. Based on the data gathered. Based on the findings, Natural enemies identified in the garden are: *Bubekia fallax* Gahan is parasitic, *Solenopsis invicta, Hemidactylus frenatus*, *Ratus ratus* are predators. The *Scolia sp.,* Megachile *chrysopyga, Apis millifera Phaenicia sericata* are competitors while *bacteria* and *fungi* are pathogens of butterflies

Key words: Natural enemies, Parasitic, Predator

INTRODUCTION

Rhopalocera Butterflies are cold blooded insects, and they are attracted to the heat of the sun. As temperature gets hotter, they become actively soaring around the plants, as if they are dancing in the air, the visible plight pattern is between 0900 to 1500, hovering around the garden (Nacua *et al.*, 2014). Butterfly search for nectarine plants to sustain their energy, species of Lyceanidae such as Zizina otis, Nakaduba Berenice, Lampides boeticus found in groups nectarine on species of Fabaceae such as Portulaca oleracea (Linn.), Arachis pintoi. *Catochrysops panormus* (Lyceanidae) were also found nectarine on species of Acanthaceae, like for instance are Asystasia gangetica, Ruellia tuberosa. Small butterflies feed on smaller size of nectarine plants.

Medium size of butterfly like *Leptosia nina* (Pieridae) were also found nectarine on species of nectarine plants such as Acanthaceae and Fabaceae, and Lantana camara (Verbenaceae). Leptosia nina are the only butterfly that flies so low over the plants. very slow, very gentle and graceful flyers compared to all species of butterflies. They are like white angel flying in the garden. Flying for more than one hour can make butterfly exhausted under the heat of the sun. They may be found perching under the expanded leaves and branches of shaded tall trees.

Strong flyers of butterfly's species Idea *leuconoe (*Nymphalida*e)* commonly perch on expanded leaves of tall trees while Melanitis *leda* are commonly found on the ground, they are hardly notice because they camouflage the dried leaves. Butterflies wings resembles the color of the rotten leaves.

Different species of butterflies has different behavior. For example, butterflies of Papilionidae like *P. demoleus, Troides rhadamantus*, *Menelaides deiphobus rumanzovia* are very selective on choice of nectarine plants, they can sense abundance of nectar and sweet scents. This could be due to high concentration of sugars in their nectar (Nacua *et al.*, 2014**)**. Mostly Male butterflies' sips on water moisture on the soil and mineral stones. The butterflies are after the various salts and other nutrients that seep from the earth as the evaporating water passes through sand, pebbles, clay, or mud (Martins, 2016).

The entire life cycle of the butterflies from eggs, larva to adult can be affected by their natural enemies. Natural enemies are organism that kills or decrease the multiplicative potential of an organism. It may limit the number of organism present in the garden. A parasite is an organism that survive in close association with its host, and later kills it. while a pathogen can be best described as bacteria, viruses and fungi. The Pathogen can be presumably found on garden soil

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including pesticide which was purchased commercially. These pathogens like fungi and bacteria, may affect chemical exchanges between roots and soil which serves as a reservoir of nutrients.

Bacillus spp. dominated the bacterial isolates while *Aspergillus spp.* was the most dominant fungus across the different sampling locations A near neutral pH was observed across the sampling sites, Bacterial and fungal abundance were typical of an environment with high species richness and functional diversity (Ogunmwonyi *et al.,* 2008). The aim of this study was to identify the butterfly's behavior and presences of natural enemies such as parasitic, predator, competitor and pathogen that interfere with the butterflies in captivity.

MATERIALS AND METHODS

Description of the study site: the study site was located at 14°35'30"N 120°58'53"E and it is adjacent to central Light Rail Transit (LRT)-1 and Liwasang Bonifacio. It is in the heart of Mehan garden, Ermita Manila. Philippines.

***Materials*:** DSLR Camera were used for documentation of butterfly behavior. Microscopes (for identification), 95% ethanol was used to immobilize the natural enemies caught in the garden, Weather station Earth AQMS. Lux meter use to determine the luminosity of light.

***Descriptive statistics*:** This provides simple summaries of data using, percent frequency method used to quantify the numbers of affected butterflies by the natural enemies present in the garden. The study commenced for one year from March 2017 up to February 2018. The observation period starts at 0800 to 1600.

Air Quality Monitoring sensor (AQMS): AQMS was used to measure the temperature and humidity that affects the Plight patterns of butterflies**.**

***Identification of natural enemies*:** Identification of natural enemies uses the following references: Introduction to the insect by Borror *et al.* (1976), Holldobler *et al.* (1991), CSIRO (1970), Hardy *et al.* (2017), Butterflies of Thailand, Ek-Amnuay (2012), Revised Checklist of the Butterflies of the Philippines. Threadaway *et al.* (2012).

RESULTS AND DISCUSSION

It was observed and recorded, that there were 20 species of adult butterflies distributed to 271 individuals (Figure 1). The 132 elusive of butterflies survived the natural enemies. These butterflies were found on the leaves and stem of the plants inside the butterfly garden. The 139 butterflies were affected by the natural enemies.

The 52 passive butterflies clinging on the insect net was killed by the voracious predator *Rattus rattus* at night and opportunistic predator *Hemidactylus frenatus* killed 55 butterflies. There were also some competitors on feeding solution, these are, *Scolia sp.* competed to 19 butterflies on a prepared diluted honey solution, *Phaenicia sericata* Competed to 11 butterflies on prepared diluted honey solution, Parasitic *Bubekia fallax Gahan* stung 2 butterflies while sipping diluted honey solution.

***Descriptions of the natural enemies*:**

A. *Solenopsis invicta* (Fire ants) (Hymenoptera: Formicidae), The descriptions, particularly those concerning the shapes of the head, thorax, and post petiole. Fire ants has the post petiole articulated on anterior surface of first gastral segment; the gaster in dorsal view not roughly heart-shaped, not capable of being bent toward over the alitrunk petiole not dorsoventrally flattened, with a node of some form. Apical and preapical antennal segments much larger than preceding funicular segments and forming a conspicuous segmented club Antennae always w/ 10 segments Palp formula 1,2 or 2,2 mandible w/ 4 dentate. Lateral portion of clypeus not flattened and prominent, not fused w/ median portion of clypeus to form a shelf forward over the mandibles anterior clypeal margin w/ single long, anteriorly projecting, unpaired median set at the midpoint of the margin propodeum always an armed and rounded. Fire ants, feed on other food

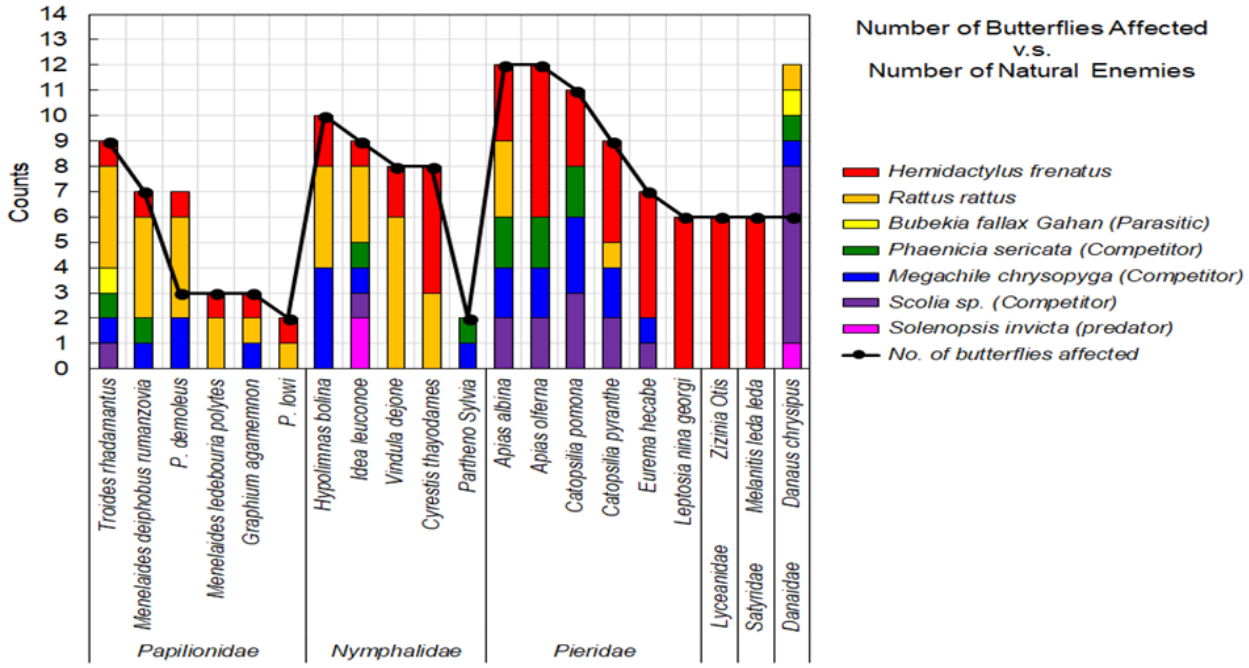
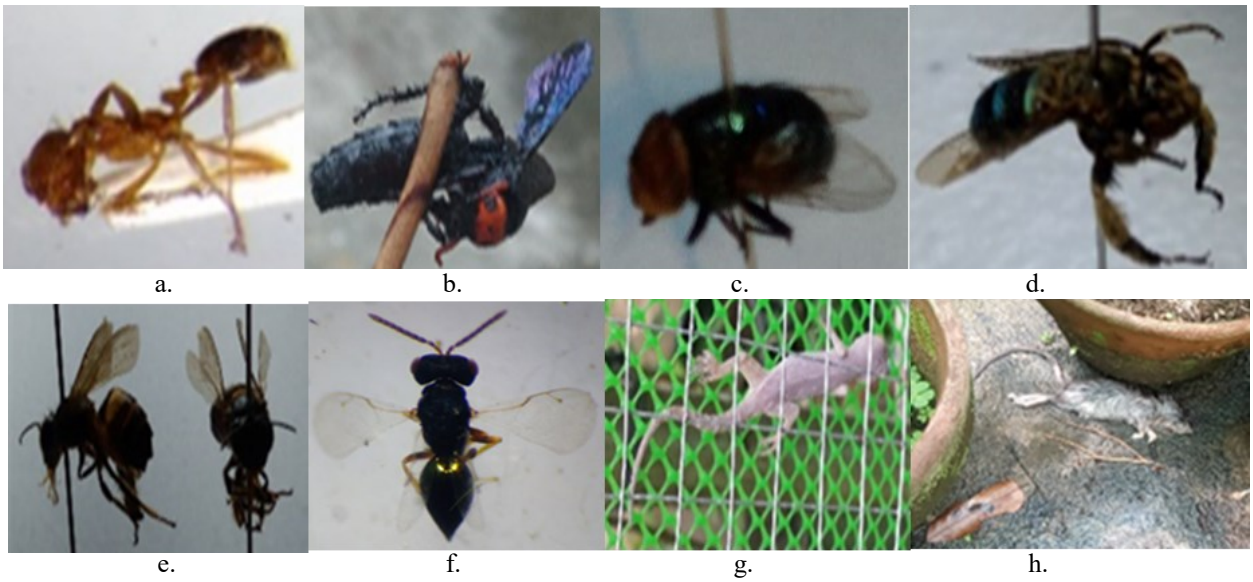


Figure 1. Number of butterflies affected versus number of natural enemies

a. b. c. d.

Figure 2. Observed parasitzed larva, pupa and adult butterflies at UDM butterfly garden. a.) *Idea leuconoe* killed by *Solenopsis invicta* b.) *Idea leuconoe*, sluggish movement with discomfort, profuse vomiting, turn black. A symptom for Bacterial infection c.) P. lowi, parasitized by Bubekia fallax. *P. demoleus* larva-fungi mummified.



a. b. c. d.

e. f. g. h.

Figure 3. Natural Enemies of butterflies at UDM butterfly garden. *a) Solenopsis invicta* Buren b) *Scolia sp.* c) *Phaenicia sericata* d) *Megachile chrysopyga* e) *Apis millifera*, f) *Bubekia fallax* Gahan, g) *Hemidactylus frenatus* (House lizard) h) *Ratus ratus* (House mouse).

substances like the sweet liquid produced by reproductive part of plant pistil with presence of nectars. They prey on all stages of developing butterfly's eggs, caterpillars, pupae and adults. The fire ants preyed on all of the swallowtail life stages. In fact, fire ants discovered all stages faster than an alternate meat food source (Wojcik *et al.,*2001).

B. *Scolia sp.* (Hymenoptera: Scoliidae), Description: Tend to be black color, often marked with yellow or orange, and their wing tips are distinctively corrugated. The Males are slenderer and elongated than females, with significantly longer antennae. *Scolia sp*. Sting butterflies when they are disturbed and threaten. It creates discomfort and itches in the skin of humans. Scolia sp. are competitors of butterflies for food as they both sips on diluted honey solution in a butterfly feeder.

C. *Phaenicia sericata* (Metallic green blowfly) (Dipthera: Calliphoridae), Description: The blow- flies are often metallic in color and have the arista of the antennae plumose to the tip. In blow flies, the hind most post humeral bristle is usually more laterally located than is the presutural bristle. Blow- flies usually have two notopleural bristle. They lay eggs on sponges and containers of sugar solution. They sting butterfly handlers and caused skin discomfort like itchiness. *Phaenicia sericata* and *Calliphoridae* are competitor on sliced oranges and diluted honey solution in a butterfly feeding bowl, unfortunately they also leave maggots in the feeder. Phaenicia sericata are vectors of pathogen since they are commonly found on dead animals, human and animal feces, rotten food outside the garden.

P. sericata, the oriental latrine fly C. megacephala and the bluebottle C. vicina showed the highest potential pathogen transmission (Maldonado *et al.,*2003**).** E. coli, a microorganism typically found in feces, was isolated from muscids and caliphorids (Lim *et al.*, 2010).

D. *Megachile chrysopyga* (Leaf Cutting bee) (Hymenoptera: Megachilidae), Description: The leaf cutting bees are mostly moderate, sized, fairly stout bodied bees, they differ from other bees in having two sub marginal cells of about equal length, the females of the pollen. Collecting species carry the pollen by means of scopa the ventral side of the abdomen rather than on the hind legs. They are competitor of butterflies in the feeder. *Megachile chrysopyga* also sips diluted honey solution.

E. *Apis millifera* (Hymenoptera: Apidae). A leaf cutter bee. The honeybees are recognized by their golden-brown coloration and form of the marginal and sub marginal cells in the front wings and the absence of spurs on the hind tibia. These are competitor of butterflies since the sips diluted honey in the butterfly feeder.

F. *Thinodytes cephalon* (Walker, 1843) (synonym): *Bubekia fallax Gahan* (Hymenoptera Theromalidae). Description: The pteromalidae are a large group of minute black or metallic- green or bronze insects. These insects are parasite and attack a wide variety of hosts; many are valuable in the control of crop pests. Figure 2 c. *P. lowi* pupa is an introduced species for observation purposes while *P. demoleus* is a common butterfly species in Mehan garden, pupa has been parasitized by *Bubekia fallax*. This is the worst natural enemy of butterflies; they

stung the larva and pupa and it caused death for the parasitized butterfly.

G. *Hemidactylus frenatus* (Reptilia- Gekkonidae), Description: Like most lizards, H. frenatus has four developed legs, a long tail, and a prehensile tongue for catching prey. Another characteristic of these geckos are their enlarged claws and adhesive toe pads. This aids their ability to climb walls and ceilings.

At the strike of 1600, opportunistic Lizard resting outside the plastic mesh slowly squeeze its body to gets inside the net to prey on butterflies. Opportunistic pest like house rats, was also actively preying on butterflies clinging on the butterfly mesh net at 1700. On Figure 3 g. house lizard attempting to get inside the plastic mesh.

H. *Rattus rattus* (Black rat rodent) Rodentia: Muridae, Description: Long tailed, black and omnivorous rat. They are excellent climber with fingers and toes that are able to firmly grasp things to aid it in this task. They use this ability to get into the butterflies resting on the insect nest. Comparing rats and butterfly's behavior: House rat are nocturnal animal's while butterflies are diurnal insects, Butterflies rest at 1600 while house rat are active at 1600. Rats are very sensitive and intelligent that they detect the best time to attack the butterflies. Having the behavioral instinct, they invade the butterfly cage from 1600 until 1800 for their feeding time. Coming from different side of direction they search for entrance going inside the garden. Identified habitat are from the stock room of old teared and outdated books of the UDM (Universidad de Manila) library and some are coming from the LRT (Light Rail Transit) station sewage system. Rats teeth are super-strong, they cut through anything like rock, metal screen and plastic mesh. They invaded the garden, and prayed on butterfly larva, pupa and the adult butterflies on the insect net. Figure 3. H, House rat caught inside the garden.

DISCUSSION

Commonly the process of developing butterflies in nature was controlled by a number of natural enemies that live together in their habitat (Ngatimin, 2018) There are 132 individuals of butterflies survived the natural enemies. With an evasive instinct behavior from predator, butterfly's species such as Idea leuconoe, *Partheno Sylvia, Troides rhadamantus, Vindula dejone, Menelaides deiphobus rumanzovia, P. demoleus Menelaides ledebouria polytes*. They were observed perching on trees and leaves of *Lantana camara, Annona muricata L. Allamanda cathartica, Hibiscus rosasinensis.* These are tall shrubs that brought shades in the garden.

Some species of butterflies of *Troides rhadamantus, Menelaides deiphobus rumanzovia* clinging on the insect mesh net at night were unfortunately prayed by the House lizards and house rats.

It was recorded, that there were 55 individual butterflies were killed by lizards and 52 individuals of them killed by the house rats. The storage room of the library where they stored old, teared books was found the habitat of the house rats (Rattus rattus), and also from the neighboring restaurant and sewage from the LRT-1. Lizards (Hemidactylus frenatus) were identified coming from the ceiling of the building of UDM.

Fire ants (*Solenopsis invicta*) Predator, were found on the pot soil. The parasitic wasp (*Bubekia fallax Gahan*), and bees (*Megachile chrysopyga* and *Apis millifera*) are migratory insects from pollen of flowering woody trees along the Mehan garden a good example are: Talisay (*Terminalia catappa*), Narra (*Pterocarpus indicus*), mango (*Mangifera indica*), Acacia (*Acacia concinna*), Tamarind (*Tamarindus indica*), Java palm (*Syzygium cumini*).

Parasitic wasp and bees, squeeze their body in the small holes of insect screen mesh, and compete with the butterflies for food. They fought for sugar solution or freshly squeezed orange or diluted honey. A cluster of bees invaded the garden and sips on diluted raw honey solution that were feed to butterflies.

Comparing sugar solution and diluted raw honey in the butterfly feeder: Wasps, bees and fly (*Phaenicia sericata*) and butterflies are more attracted to herbal sweet scent of diluted honey solution as source of food. Competing in the feeding source, Wasp bees are territorial insect specially the male bees they never like to share. they stung butterflies and shooed them away from the bowl of feeding sourced.

It was observed that, freshly squeezed orange juiced on a butterfly feeder, fed on butterflies extend their life span. Normally, Average life span of Idea leuconoe last until 42 days Cabras et al . However, butterflies continuously feed with freshly squeezed orange, and water, sipping on mineral stone in the garden lasted for 60 days. If not for the natural enemies, it could had been survive for a little bit longer than 60 days.

Butterflies can withstand the heat of the sunshine. A temperature of 30 to 32 degrees Celsius (36616 LuX) luminosity of light is tolerable for butterflies at UDM butterfly garden. Installed the weather station, recorded an Urban heat with the average temperature 30.6 to 39°C and humidity recorded 76 %. From 0800 to 1600 mostly butterflies are actively hovering in UDM butterfly garden Ermita Manila.

From 33 to 39 Degrees Celsius was very exhausting already for the Butterflies, with this temperature butterflies were found resting in the shaded expanded leaves of Dracaena plants, thick branches of shrubby plants of *Lantana camara*. *Menelaides polytes ledebouria* found sipping moisture on the ground presumed to be attracted to minerals on the soil, and when tested the body of the butterfly it contained traces of Na + and K+. These minerals help the butterfly to sustain its plight pattern during mating period. Sipping moisture on the ground. Male butterflies observed puddling on the wet stones followed by mating (Nacua, 2019).

It was noted that the plight pattern behavior butterfly is changing. Butterflies of La Union Botanical Garden were appeared soaring in the sky from 0900 to 1500 with a temperature ranges from 24-36Ċ (Nacua *et al*., 2015). Here in UDM butterfly garden, Ermita Manila, butterflies are visible soaring in the sky from 0800 to 1600 at the temperature 30.6 to 39 °C. An Indicator of weather temperature is averagely rising up.

It was interestingly recorded, that butterflies found sips moist on the ground soil and stones around the garden before mating. It was tested that soil and rocks in the garden contained dissolved minerals in the form of sodium (Na) 2780 ppm. Sodium on rocks and soil promotes endurance for male butterflies for a long hours of mating times which was observed on species of *Idea leuconoe* (Nymphalidae) and *Papilio demoleus* (Papilionidae). However, Magnesium and Calcium on soil and rocks were not detected.

Sodium derived from puddling has been shown to act as a nuptial gift in a few Lepidoptera species, it can also be used for neuromuscular activity in both males and

females and Normally, the average life span of the butterflies was about 7 days to 14 days depending on the species (Molleman, 2005).

The ecological triad (external agent, susceptible host, and an environment).

Firstly, the pathogen, and the degree of virulence, Second susceptibility or resistance of the butterfly species, Third, the condition of the environment. Communicable disease found are bacterial and fungal infection. The genus *Ophiocordyceps* were a presumed species of fungi known to parasitize many kinds of butterfly larvae like *P. demoleus* of Figure 2. d, Fungi infected *P. demoleus* larvae and failed to pupate to become adult butterfly. *Ophiocordyceps sinensis* can colonize plants, which are also the caterpillars' host plants and they may be infected (Yoon *et al*., 2008) The infected caterpillars then, under appropriate conditions, become muscardine cadavers and transform into *O. sinensis* teleomorphs with the valuable fruit bodies (Lei *et al.*, 2015).

Pathogens based on Signs and symptoms

Many pathogens, including those infecting insects, are transmitted via dormant stages shed into the environment, where they must persist until encountering a susceptible host (Satterfield *et al.,* 2017). Studies have considered how intrinsic host and parasite properties determine parasite virulence but have largely ignored the role of extrinsic ecological factors in its expression (Jacobus *et al.,*2008).

Bacteria (pathogen) was observed on *Idea leuconoe* larva on Fig. 2. B. The manifested symptoms on butterfly larvae, poorly lethargic, curling, and turn to black color described a black death. A few pupated and turned to blackish coloration. Another symptom for bacterial infection. This posed a threat to other butterflies and communicable diseases. Bacterial diseases caused death among infected caterpillar, usually coupled with a blackening of the body, and exudation of a foul-smelling liquid.

The larvae of *Hypolimnas bolina* lost appetite, with profuse diarrhea and discoloration; presence of cocci and or bacilli under the microscope is a symptom of a bacterial infection of larva and pupa observed at LUBG (Nacua *et al.*, 2015).

Some viral infections on butterfly larvae had a manifestation of disfigurement, throw up with a foul odor or worst died with no symptoms. Infected larvae of D. chrysipus glided towards the top where larva stop feeding on leaves; inclusion bodies appeared under the microscope observed at LUBG (Nacua *et al.*, 2014**)** Nucleopolyhedroviruses are DNA viruses that only infect the larval stage of Lepidoptera (Judith, 2015).

Fungal infection on butterfly larva. Powder white mildew, very tiny stiff and mummified larvae observed on *P. demoleus*, *Idea leuconoe*, *Danaus chrysipus*. Host plant and fungi illustrate symbiotic relationship that convert nitrogen into biological useful forms. In return, fungi absorb sugar that the plants produce through photosynthesis. It was noted that a fruity fragrance exudes in the *Papilio demoleus* of a freshly died caterpillar infected by fungi Figure 2 d.

A symptoms of fungi infection are Mummified tissue larva of P. rhadamantus indicative of mycelium and spore under the microscope observed at LUBG (Nacua *et al.*, 2014).

Natural way of controlling contaminants has been performed. The poor Infected butterfly larva either bacterial or viral were isolated and burned. Contaminated soil pot plants with infected larva and pupa has been remove and transferred outside the garden to recover under the sun. Strong sunlight and air circulation is important for the plants to keep the plants from diseases that may be contaminate the butterflies. Butterfly handlers ensured to wash hands and step on disinfectant mat before and after entering the butterfly garden.

CONCLUSION

Based on the recorded data, it was concluded that natural enemies identified in the garden are: *Bubekia fallax* Gahan is parasitic, *Solenopsis invicta*, *Hemidactylus frenatus*, *Ratus ratus* are predators. The *Scolia sp*., *Megachile chrysopyga, Apis millifera Phaenicia* sericata are competitors while bacteria and fungi are pathogens of butterflies were only based on signs and symptoms.

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